



AI04, AAPT Summer 2003 Meeting

Locus of Control - Chance or Self-Attribute?*

Vince H. Kuo

Patricia Heller, Ken Heller

Physics Education Research Group
<http://groups.physics.umn.edu/phised>

*Supported in part by University of Minnesota and NSF grant #DUE-9972470



Outline: a guide for discussion

- **What is Locus of Control (LOC), & why do we care?**
- **What have others found?**
- **What have we done?**
- **What have we found?**





What is LOC?

“... the degree to which the individual perceives that the {outcome} follows from, or is contingent upon, his own behavior or attributes **[internal]** versus the degree to which he feels the {outcome} is controlled by forces outside of himself and may occur independently of his own actions **[external]**”

Julian B. Rotter, 1966

- Used by Mary Budd Rowe (1974) in her groundbreaking study on wait-time & rewards
 - 1st through 6th grade science students

“Bowler”



“Craps Shooter”





Why do we care?

- Faculty beliefs showed a focus on the importance of motivation to learning problem solving in physics – U of Mn
 - **Internal** LOC lead to higher motivation since belief is that what they do matters
 - **External** LOC lead to lower motivation since belief is that what they do doesn't matter
- MPEX results showed deterioration in students attitudes, beliefs, & assumptions relative to expert physicists – Redish, E.F., Steinberg, R.N., & Saul, J.M. (1998)
- As part of an on-going evaluation on the introductory physics courses at U of Mn
 - Students' LOC
 - Physics course does not affect students in a way that makes them significantly more **external!!**



Rotter I:E Scale

- **Developed for general population to measure belief / expectations about how reinforcement is controlled**
- **Instrument tested extensively for validity & reliability on diverse populations**
- **Easy to administer (~ 15 minutes)**
- **Easy to grade (Machine)**
- **Used by lots of researchers on different populations (but just not in physics)**
- **Expert physicists would be very **internal****
- **Rotter I:E Scale (29 items)**
 - **Situated in everyday experiences**
 - **Some items deal specifically with academics (some are placebos)**
 - **Agreement to 1 of 2 statements / item**
- **Factored into 2 subscales**
 - **Social** (political and world affairs)
 - **Personal** (personally relevant events)



Rotter I:E Scale – Social Example

1.
 - a. Children get into trouble because their parents punish them too much.
 - b. The trouble with most children nowadays is that their parents are too easy with them.
2.
 - a. Many of the unhappy things in people's lives are partly due to bad luck.
 - ✦ b. People's misfortunes result from the mistakes they make.
3. ✦
 - a. One of the major reasons why we have wars is because people don't take enough interest in politics.
 - b. There will always be wars, no matter how hard people try to prevent them.
4. ✦
 - a. In the long run people get the respect they deserve in this world.
 - b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.
5. ✦
 - a. The idea that teachers are unfair to students is nonsense.
 - b. Most students don't realize the extent to which their grades are influenced by accidental happenings.



Rotter I:E Scale – Personal Example

6.
 - a. Without the right breaks one cannot be an effective leader.
 - ★ b. Capable people who fail to become leaders have not taken advantage of their opportunities.

7.
 - a. No matter how hard you try some people just don't like you.
 - ★ b. People who can't get others to like them don't understand how to get along with others.

8.
 - a. Heredity plays the major role in determining one's personality.
 - b. It is one's experiences in life which determine what one is like.

9.
 - a. I have often thought that what is going to happen will happen.
 - ★ b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

10.
 - ★ a. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.
 - b. Many times exam questions tend to be so unrelated to course work that studying is really useless.



What have others found?

Overall



- **Rotter (1966)** – introductory psychology students and Peace Corp volunteers; **Knoop (1981)**; **Pascarella, Edison, Hagedorn, Nora, & Terenzini (1996)** – general college population
 - College population tended to be **internal**



What have others found?

Gender



- **Parsons & Schneider (1974)** – university psychology, social science, & education students
 - Females were **less internal** than males
- **Khanna, Molinari, & Khanna (1977)** – general liberal arts college population
 - Females were **more external** than males
- **Lee & Dengerink (1992)** – general state university population
 - No statistically significant difference in gender
 - Both groups were **internal**

May be the result of changes in the social climate



What have others found?



Achievement – based on various course assessments

- **Lefcourt (1976, 1981-1984); Phares (1976); Stipek & Weisz (1981); Main & Rowe (1993)** – various general populations from elementary to college
 - Indications that **Internal** Locus of Control → higher achievement
- **Daniels & Stevens (1976)** – general college population
 - **Externals** perform just as well as **internals** in teacher controlled courses
 - **Internals** perform better than **externals** under contract for grade plan
- **Results appear to depend somehow on differences in instructional methods (?)**



What have we done?

Data Collection

Administered by a large variety of TA's

- **Rotter I:E Scale Pre & Post**
- **FCI / CSEM Pre & Post**
- **Course Grades, Final Exam Scores**

Fall 2002

- **1st semester calculus-based courses (N = 283)**

Spring 2003

- **2nd semester calculus-based courses (N = 283)**

Spring 2003

- **1st semester calculus-based courses (N = 205)**
- **1st semester algebra-based courses (N = 85)**
- **1st semester courses for biology majors (N = 146)**



What have we done?

Data Analysis

Rotter I:E Scale Overall Δ 's

Rotter I:E Scale Social Δ 's

Rotter I:E Scale Personal Δ 's

- **Separated by Gender**
- **Relationship with**
 - **Course %**
 - **Final Exam% (MC % & PS %)**
 - **Pre & Post FCI %'s**
 - **Pre & Post CSEM %'s**



What have we done?

Data Analysis

Rotter I:E Scale Overall Δ 's

Rotter I:E Scale Social Δ 's



Rotter I:E Scale Personal Δ 's

- **Separated by Gender**
- **Relationship with**
 - Course %
 - Final % (MC % & PS %)
 - Pre & Post FCI %'s
 - Pre & Post CSEM %'s



What have we found?

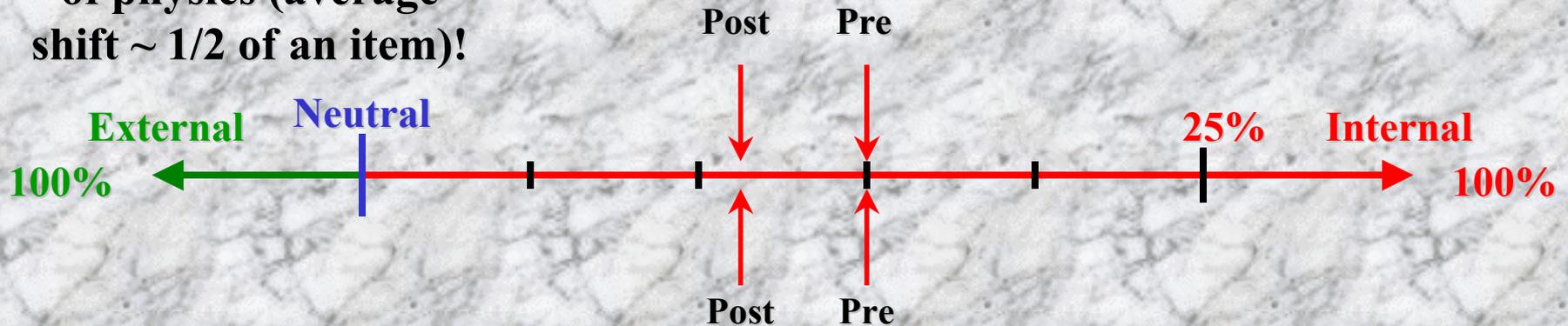
Personal Results

All students were found to be **internal**

Used Sign Test* to see if courses exhibit any significant trends

Pre / Post differences
(10 courses)

9 out of 10 courses
shifted towards **less
internal** direction by
the end of one semester
of physics (average
shift $\sim 1/2$ of an item)!



* Howell, D.C., Statistical Methods fro Psychology (4th Ed). Wadsworth Pub. Co., Belmont, CA (1997)



What have we found?

Personal Results

All students were found to be **internal**

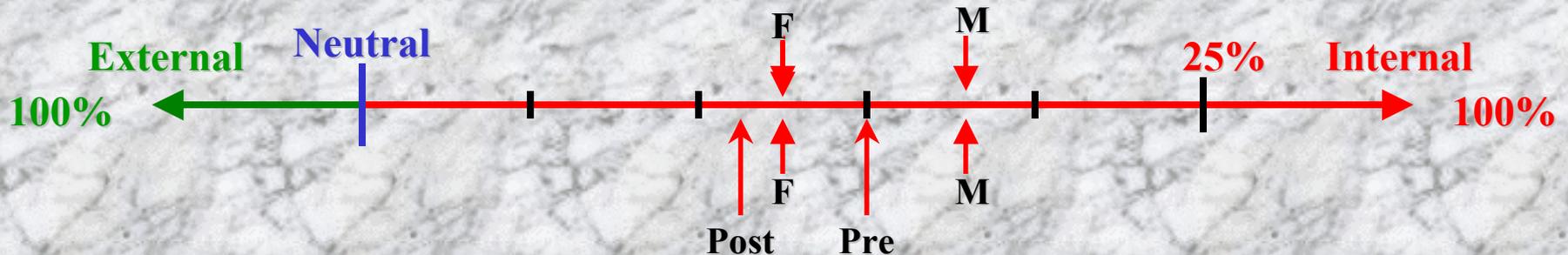
Used Sign Test* to see if courses exhibit any significant trends

Pre / Post differences
(10 courses)

M / F differences Pre
(10 courses)

9 out of 10 courses shifted towards **less internal** direction by the end of one semester of physics (average shift $\sim 1/2$ of an item)!

8 out of 10 courses had females **less internal** than males before the physics course (average difference $\sim 2/3$ of an item)!



* Howell, D.C., Statistical Methods fro Psychology (4th Ed). Wadsworth Pub. Co., Belmont, CA (1997)



What have we found?

Personal Results

All students were found to be **internal**

Used Sign Test* to see if courses exhibit any significant trends

Pre / Post differences
(10 courses)

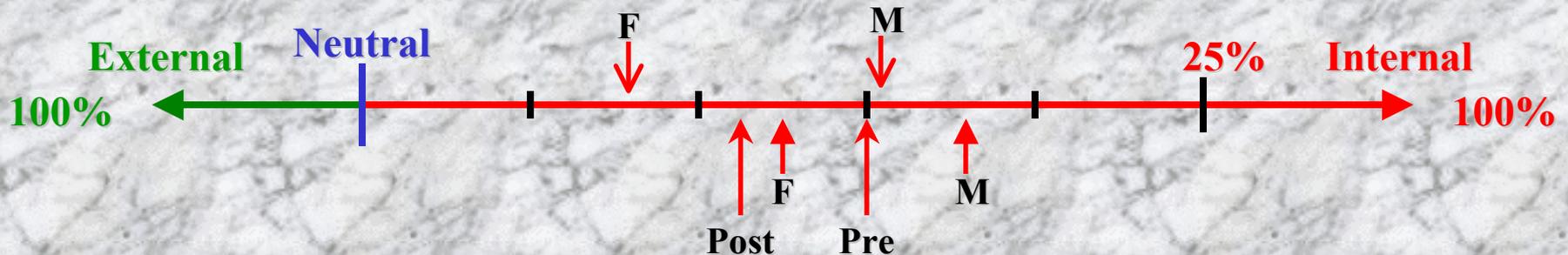
M / F differences Pre
(10 courses)

M / F differences Post
(10 courses)

9 out of 10 courses shifted towards **less internal** direction by the end of one semester of physics (average shift $\sim 1/2$ of an item)!

8 out of 10 courses had females **less internal** than males before the physics course (average difference $\sim 2/3$ of an item)!

8 out of 10 courses had females **less internal** than males after the physics course (average difference ~ 1 item)!



* Howell, D.C., Statistical Methods fro Psychology (4th Ed). Wadsworth Pub. Co., Belmont, CA (1997)



What have we found?

Data Analysis

Rotter I:E Scale Overall Δ 's

Rotter I:E Scale Social Δ 's

Rotter I:E Scale Personal Δ 's

- Separated by Gender

- Relationship with

- Course %
- Final % (MC % & PS %)
- Pre & Post FCI %'s
- Pre & Post CSEM %'s





What have we found?

Relationships ...

Used Sign Test* to see if correlations exhibit significant trends

12 correlations overall

Pre & Post Personal LOC measures & 6 course assessment measures

- **Calc-based mechanics courses had**
 - 12 out of 12 correlations are consistent with notion **internal** → **higher achievement** (probability ~ 0.002)
- **Calc-based E&M course & course for biology majors had**
 - 11 out of 12 correlations are consistent with notion **internal** → **higher achievement** (probability ~ 0.003)
- **Algebra-based course had**
 - 10 out of 12 correlations are consistent with notion **internal** → **higher achievement** (probability ~ 0.02)

* Howell, D.C., Statistical Methods fro Psychology (4th Ed). Wadsworth Pub. Co., Belmont, CA (1997)



What have we found?

Summary



- Our sample of students were found to hold an **internal** belief on personal LOC
- Although differences were found, they were not educationally significant ...
 - Courses tended to be **less internal** at the end of one semester of intro physics course than they were at the beginning
 - Females tended to be **less internal** than males pre & post physics course



What have we found?

Summary



- **Correlations between personal locus of control & various physics course assessments tended to show the trend that **more internal** → **higher achievement****



What have we found?

Preliminary Conclusion

1. Students come into the introductory physics courses having a belief that is **internal** on Personal LOC
2. Introductory physics courses did not appear to have changed the students' beliefs on Personal LOC much
3. Course trends appeared to reconfirm previous finding that **more internal** → **higher achievement**

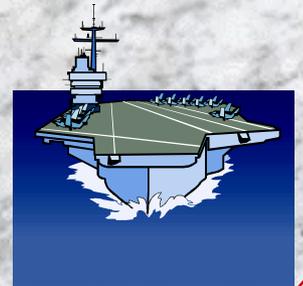
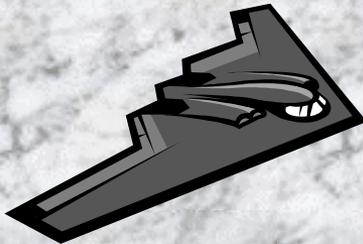
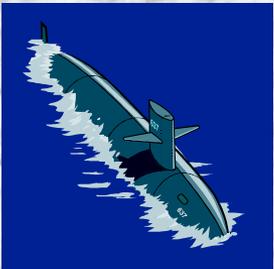


What have we found?

An Interesting Sidebar ...



- Sign Test on the Social subscale of the Rotter I:E Scale showed an across-the-board shift from **neutral** to **external** only during the Spring semester
- Would not have expected the views on political items to change ...
- Something significant happened ...





The End

Please visit our website
for more information:



<http://groups.physics.umn.edu/physed/>



Rotter I:E Scale

- 11.  a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.
b. Getting a good job depends mainly on being in the right place at the right time.
- 12.  a. The average citizen can have an influence in government decisions.
b. This world is run by the few people in power, and there is not much the little guy can do about it.
- 13.  a. When I make plans, I am almost certain that I can make them work.
b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.
- 14. a. There are certain people who are just no good.
b. There is some good in everybody.
- 15.  a. In my case getting what I want has little or nothing to do with luck.
b. Many times we might just as well decide what to do by flipping a coin.
- 16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.
 b. Getting people to do the right things depends upon ability, luck has little or nothing to do with it.



Rotter I:E Scale

17. a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.
★ b. By taking an active part in political and social affairs the people can control world events.
18. a. Most people don't realize the extent to which their lives are controlled by accidental happenings.
★ b. There really is no such thing as "luck."
19. a. One should always be willing to admit mistakes.
b. It is usually best to cover up one's mistakes.
20. a. It is hard to know whether or not a person really likes you.
★ b. How many friends you have depends on how nice a person you are.
21. a. In the long run the bad things that happen to us are balanced by the good ones.
★ b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.



Rotter I:E Scale

22. ✦ a. With enough effort we can wipe out political corruption.
b. It is difficult for people to have much control over the things politicians do in office.
23. a. Sometimes I can't understand how teachers arrive at the grades they give.
✦ b. There is a direct connection between how hard I study and the grades I get.
24. a. A good leader expects people to decide for themselves what they should do.
b. A good leader makes it clear to everybody what their jobs are.
25. a. Many times I feel that I have no influence over the things that happen to me.
✦ b. It is impossible for me to believe that chance or luck plays an important role in my life.



Rotter I:E Scale

26. ✦ a. People are lonely because they don't try to be friendly.
b. There's not much use in trying too hard to please people, if they like you, they like you.
27. a. There is too much emphasis on athletics in high school.
b. Team sports are an excellent way to build character.
28. ✦ a. What happens to me is my own doing.
b. Sometimes I feel that I don't have enough control over the direction my life is taking.
29. a. Most of the time I can't understand why politicians behave the way they do.
✦ b. In the long run the people are responsible for bad government on a national as well as on a local level.



What have we found?

Personal Results

- **Due to doing multiple comparisons**
 - Use more conservative levels of α for each comparison to reduce Type I error
 - Set overall Familywise error rate at $\alpha = 0.01$
 - Using *Bonferroni t*, or *Dunn's Test*

$$\alpha' = \alpha / c *$$

α' = significance level of each comparison

c = number of comparisons

- Sign Test *

$$p(k) = \sum_{i=k}^N \frac{N!}{i!(N-i)!} (0.5)^i (0.5)^{N-i}$$

N: total number of events, **p(k):** probability of k-occurrences in N events

* Howell, D.C., Statistical Methods fro Psychology (4th Ed). Wadsworth Pub. Co., Belmont, CA (1997)